

Using Computer Games in Online Education: What Are Students Really Learning?

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Abstract This presentation will introduce the research background on the use of computer games in online education. Arguments for and against the use of online educational gaming will be discussed. The role of game designers/developers is presented. The conclusion recommends that online educators chose and use online games wisely.

Introduction

Video-type games have been considered a leisure time activity for over 25 years (Bryce & Rutter, 2003). Children and teenagers spend hours playing games on the computer or the X Box, “making computers a significant part of young people’s everyday lives”(DeBell & Chapman, 2004, p.37). With the convergence of technology, computer games are now also played on the family television, handheld devices, cell phones and even digital watches (Bryce & Rutter, 2003).

DeBell & Chapman (2004) found that “a majority (59 percent) of 5-through 17-year-olds use home computers to play games...Sixty to sixty-three percent of middle-school-age and high school-age youth (ages 11-17) use home computers to play games” (pp. 37). On average, the American teen spends 1.5 hours per day playing such games, which translates into 550 hours of game playing each year. Boys used computers to play games more than girls did. Playing computer games is second only to completing school assignments, e-mail and instant messaging as an Internet activity (DeBell & Chapman, 2004). Nationwide data on the use of computer games by high school sophomores who participated in the Educational Longitudinal Study of 2002 (ELS, 2002) confirmed the same patterns of computer time use. (ELS, 2002)

Considering the popularity of computer games, it is not surprising that educational games have been created. A game that is both entertaining and educational is often called edutainment and according to ESA (2003), this type software accounted for 7.6% of computer game sales in 2002. Computer games have increasingly become part of the online environment (e.g. Shockwave’s Flip Words, 2004). Web Course Tools (WebCT), one of the course management systems, shows examples of online games such as the Learning Objects Game show (WebCT, 2004).

Education Arcade chronicles educational online gaming as an emerging technology trend.

When we began work two years ago, there was no real evidence that high quality educational games could be made or could be effectively used. Through the Games-to-Teach Project, a Microsoft iCampus initiative with the Comparative Media Studies department at the Massachusetts Institute of Technology, we began to explore key issues in the use of a wide variety of media in teaching and learning. Based on our survey work, we then developed a suite of conceptual frameworks to support learning across math, science, engineering, and humanities curricula. Working with top game designers from industry and with faculty across MIT’s five schools, we conceived 15 game concepts and supporting pedagogy for how advanced math and science content could be blended with game play in unique ways, as well as models for supporting humanities education (Education Arcade, 2004)

Even online instructional time is at a premium. Is it appropriate to instruct students using these popular computer games? What are the positive and negative effects of such pedagogy? The purpose of this presentation is to explore the research and data on computer games in online education.

The Learning Theory Basis for Online Computer Games

Instructional tools, such as online computer games, should apply widely accepted theories of learning and cognitive research, and should not be used based solely on entertainment or ready access. Some of those theories which justify using multimedia games in online education are the Theory of Multiple Intelligences (Gardner, 1993), the Constructivist Theory (Bruner, 1960) the Cognitive Flexibility Theory (Spiro & Jehng, 1990), the Dual Coding Theory (Paivio, 1986), the Cognitive Load Theory (Sweller, 1988), and the Multimedia theory (Moreno & Mayer, 2000).

According to Howard Gardner's Theory of Multiple Intelligences (Gardner, 1993), within the learning population, there are at least eight different learning styles. In other words, according to Forcier and Descy (2002), Gardner believes that people have different ways in which they learn best, and individuals learning styles define how they acquire and process knowledge. In an online class, it is the teacher's responsibility to present material in a way which accommodates all learning styles. A multimedia game presents material using sound, tactile manipulation, graphics and sometimes text to present the message, catering to many learning styles.

The Constructivist theory (Bruner, 1960) is based on the work of Piaget and relies on the premise that students construct new knowledge based on their prior experiences. The teacher is the facilitator rather than the director of a person's education (Forcier & Descy, 2002). In a video game, students learn by exploring the game environment through trial and error.

The Cognitive Flexibility Theory, a Constructivist-type approach to learning, suggests that material be presented in small chunks linked together in the learning environment (Spiro & Jehng, 1990). Each chunk of information should build on the previous chunk or the same material should be presented in several situations. It is best used for complex materials. The Cognitive Flexibility Theory provides for multiple knowledge representations that are made possible by multiple passes through the same material and is meant to engage students in critical thinking (Hites & Schrank, 2001; Spiro et. al. 1997; Spiro et. al. 1991). Based on this theory, when students are required to apply what they have learned to multiple unique situations, they are better able to transfer the knowledge to real world situations. In a computer game, since the learning is intertwined within the gaming environment, the same information is presented several times in different, and often progressively more challenging, situations.

The Dual Coding Theory suggests that when information is presented simultaneously in both visual and verbal forms and the learner is able to connect those two forms, transfer to long-term memory is more likely to occur. (Paivio, 1986). The premise of the theory is that since there are two representations of the same information, if one representation is lost, the probability of recall is increased due to the availability of the second representation (Rieber & Kini, 1991; Rieber, 1991; Mayer & Anderson, 1992; Mayer & Sims 1994). Typically, in a multimedia game, information is presented in more than one format at the same time, therefore applying this theory.

Directly contradicting the Dual Coding Theory, the Cognitive Load Theory (Spiro & Jehng, 1990) states that when text and an animated graphic are presented on the screen at the same time, they cannot both be processed because both representations require the same sense (sight) to process the information causing cognitive overload. In fact, research by Moreno & Mayer (2002) does show that students, who are presented with an animated graphics and text at the same time, do not recall as well as students who see the text and graphics at separate times.

The Multimedia Theory is based on the Dual Coding Theory, Cognitive Load Theory and Constructivist Learning Theory. According to Moreno & Mayer, (2000) "the Multimedia Theory is based on the following assumptions: (a) working memory includes independent auditory and visual working memories, (b) each working memory store has limited capacity, (c) humans have separate systems for representing verbal and non-verbal information, (d) meaningful learning occurs when a learner selects relevant information in each store, organizes the information in each store into a coherent representation and makes connections between corresponding representations in each store" (pp. 43). The Multimedia Theory is an attempt to explain how humans learn in a multimedia environment such as video games.

Arguments for Computer Games in Online Education

Students, who are expert computer game players, have learned to process more information more quickly than non-players (Hostetter & Clemens, 2002). The general characteristics of a video game player fit well into the educational setting. First, in a video game, the student gets immediate feedback, which is

much quicker than feedback the student gets from the online instructor. Next, a video game allows students to work at their individual pace. Third, most video games allow the user to set the level to accommodate their own needs and to adjust to their unique learning styles. Additionally, computer games typically contain challenge, curiosity, fantasy, and control, which are all elements commonly found in a motivating learning environment (Rieber, 1996; Hostetter & Clemens, 2002). The computer games become progressively more challenging as the game levels increase so that the same problems are presented but in different context. Fifth, video gamers tend to have a more vivid imagination since many of the games they play are set in a fantasy world (Hostetter & Clemens, 2002). Next, simulation type software allows students to experience real life situations without the dangers, time constraints and expense of the real life situation, which would be absent from online education anyway (Forcier & Descy, 2002; Hostetter & Clemens, 2002). The students can construct their own learning or knowledge. Finally, video games help students learn symbols and graphic representations similar to math symbols (Hostetter & Clemens, 2002). Video games present information in multiple ways to accommodate a wide range of learning styles.

Arguments Against Computer Games in Online Education

Immersive gaming can be very addictive. A potentially addictive form of gaming, immersive Virtual Reality (VR), for example, can also be very expensive and hard-to-track within an online educational setting. Since immersive VR often includes head mounted displays, earphones and motion-sensing data gloves, motion sickness and other after-effects are common (Mania & Chambers, 2001). In the environment of online education, the instructor is not present to monitor the students' physical, mental and emotional reactions or to offer assistance when such reactions become detrimental to student learning.

Computer games in online education are not real-life experiences such as video field trips would be. Dr. Joel Steinberg, professor of pediatrics at the University of Texas Southwestern Medical Center at Dallas, warns that online games can even trigger aggression, creating long-term negative emotional consequences for the teenage learners. When online game players "run into a roadblock on a computer game, they may destroy it, and that is not appropriate in real life" (Steinberg, 2003, pp. 7).

In addition to arguments that computer games are addictive, expensive, hard-to-monitor, and promote aggression, the non-gaming generation sees the purpose of computer games as play, not work or serious study (Hostetter & Clemens, 2002). At the very least the gaming siphons online time away from more mundane instructional activities. Learning through online games is not a stand-alone pedagogy as much as it is instrumental to and supportive of the pedagogy. It is reasonable to conclude that online instructors may not even have access to educational games which would be relevant to their class objectives. At best, greater preparation time demands would be made for instructors to adapt the games into their syllabi.

Finally, there is evidence that minorities and females are portrayed less favorably in computer games than majority males. The Children Now Foundation accuses computer games of racial and gender stereotyping, violence and age-inappropriateness (Children Now Foundation, 2001). While such disadvantages were not studied in educational online games, their effect on leisure online gamers is real, many of which are the very same students.

The Role of Game Designers/Developers

The role of the game designers/developers is to develop educational games that enhance the curricula or at least teach the objectives. To accomplish such a task, it is important for the game designers and developers to:

- Understand how the target audience interacts with the computer.
- Understands the target audience in terms of age appropriateness, interests and motivators.
- Look at the required educational content and motivational elements to come up with acceptable representation.
- Consider different learning styles.
- Consider other classroom activities and time constraints.

- Provide supplemental materials and strategies for integrating the game into other classroom activities.
- Be creative in rewards and navigation and other features to make the game fun.

Conclusion

In order for computer games to enhance online student learning, the games must be chosen carefully and used wisely. It is the teacher's responsibility to choose challenging online educational games which apply coursework in unique ways. Game-enhanced online instruction should be balanced with traditional online pedagogy to minimize the drop in motivation when the novelty wears off and to decrease the risk of addiction to gaming.

Today's students grew up playing games and it has changed the way they learn. Gaming is part of their culture. Students love to play computer games because games are fun. Play is an essential part of the learning process throughout life and should not be neglected. Play, that is serious and focused within a learning environment, can help learners construct a more personalized and reflective understanding. Computer games offer a new possibility for wedding motivation and self-regulated learning within a constructivist framework, one which strives to combine both training and education, practice and reflection, into a seamless learning experience (Rieber, Smith & Noah 1998, pp. 35).

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